Levi the Gene

An Honors Thesis (Honrs 499)

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Thesis Advisor

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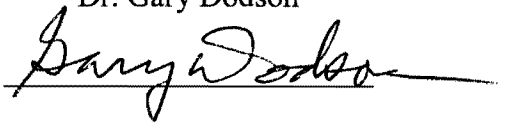

Ball State University

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Abstract

An educational children's book is worth its weight in gold. Both parents and educators know the value of literature that makes learning fun. It is vital that the next generation have a greater understanding of the concepts of genetics, as it was that the previous generation had the ability to use and understand computer technology. As research in the area is augmented, gene therapies, genetic engineering and modification, and cloning technology will become more a part of everyday life. This is especially true in the medical profession. Without an understanding of the base concepts of genetics, this growing field would be a chasm of ignorance and anxiety for society. It is true of human psychology that if we do not understand something, we fear it. This has already begun with legislation that seeks to ban all cloning technology in the United States. I do not want to see this unfortunate result come to pass in future years, and the only cure for ignorance is information. With this children's book, I hope to alleviate some small amount of ignorance and create a more informed public. One that is capable of deciding if research to society if it is ethical based on its value to society. In the process, I would like to combine art with science into an educational format.

Acknowledgements

I would like to thank Dr. Gary Dodson for advising me during this project. His thoughtful enthusiasm and suggestions were greatly appreciated during the creation of Levi. I would like to thank his wife as well, for providing the prospective of an educator.

I would like to thank Dr. Barb Stedman for her constant creativity and support. Her correction of technical errors and thoughtful commentary were immensely helpful.

A special thanks goes to Dr. Susan McDowell. Without her infectious laughter and encouragement, I would not have had the faith in myself to make Levi the best that he could be.

Without my family, whose suggestions enabled me to see from the perspective of a non-biologist, Levi would not have been all that he is now. Thank you.

To Jonathan Barnhart, whose constant calm, good humor, and technical support, made all the difference, thank you.

Works Revisited

What I Wanted to Accomplish with my Senior Thesis

When I first met with Dr. Barb Stedman to discuss my senior thesis, I had a clear idea in my head for the combination of art and science. Both visual art and biology have been my two passions since first entering higher education. My one dismay while at Ball State University has been that I have not had the opportunity to take art classes, as my science classes took up the majority of my schedule. Although I was saddened at first, the humanities courses in the honors curriculum allowed me to continue my fascination with the arts. Given the opportunity to do a creative project instead of a more research oriented paper or study allowed me to combine these two seemingly separate areas of study and create something new and refreshing after my many years of work in the more traditional areas of study. I conveyed this desire to my thesis advisor, and originally proposed the idea of taking the many beautiful images that I had seen in my work with the microscopic world and turn it into a children's book. My reasoning behind this was that children needed to be exposed to the beauty in the world of the unseen beneath a microscope. This could encourage future scientists that have a creative side in research and biology.

It has been my experience that many researchers and scientists have respect for the arts, but do not consider themselves to be artists in any form. I find this distressing, because there is the opportunity for abounding imagination and originality in research. The research field benefits by having an artistic side. The overall goal of research is to eventually present findings to the general public in the hopes that the information garnered will be put to some use in benefiting society. Being able to create visual

diagrams and creative representations of the complex ideas and theories would prove immensely valuable in the transmission of this information to the public. Anybody can present at a scientific meeting, but it takes a massive amount of thought and creative ability to pass on information in such a way that someone outside of the scientific community would be able to understand it and walk away a more informed person. I learned this as a university tutor teaching biology and chemistry for two years. My ultimate goal all along was to teach somebody, somewhere, a little bit more about biology while using art to do so.

Time to Start Over

As work began and I compiled sketches and paintings of aspects of the microscopic world, I ran into the problem of what to do with them. I had a pile of creative works and no idea of how to incorporate them into a children's book. After sitting with the sketches over Thanksgiving break, I decided that I would add text underneath them explaining what they were. Once this was done, I began to show my partly finished first draft of a children's book to anyone in my family that would give me enough time to look at it. Many people were impressed with the artistic representations of bacteria, the microscopic images, and the many other things that were not visible to the human eye. However, problems began when I started asking questions to assess whether or not the information as well as the art was being absorbed. The understanding of the material was not being synthesized even as marginally well as I would have hoped. This was not to be an art project. I wanted it to be an educational project that married art and science, with the emphasis being on education. The time had come to reinvent what I

was going to do with the project to accomplish my goals of using art to induce an understanding of the sciences.

Where Levi the Gene Came From

In a state of frustration and dismay over the work that I had already done being essentially worthless, I brainstormed. How could I get the understanding across to the reader of my children's book? I had no idea how to process four years worth of study into a form that children could understand. In talking to my family about how I could accomplish this I started to question them about what they knew about biology. I found that they knew almost nothing at even the most basic level. Shocked, I decided to do a little bit of research and ascertain if other people from different educational backgrounds had the same level of ignorance about the concepts of biology. I formatted a questionnaire and interviewed friends and their relatives, coworkers, neighbors, old high school teachers, and college professors in the non-science fields to evaluate the level of understanding in a wide cross section of society. I integrated people of all age levels into my study, starting with my target audience of early to middle teens and incorporated everyone else above that age group. I also interviewed people from different educational levels, both in and out of the area of biology. In doing so, I found that, without exception, if someone did not have a degree in biology or another related health science, even the most basic of concepts were something of a complex dilemma. This provided me with a starting point for my children's book. I would start at the beginning and educate people from there. The question now was: how was I to incorporate art and science to explain these complex ideas without making it so tedious that the reader would fall asleep?

The idea for Levi came as a frustrated bit of sarcasm spoken to my family when I had utterly run out of ideas as to the form in which I would use for the children's book. My mother, over a bit of coffee and many underappreciated attempts to get me to release my aggravation and think clearly, said that I was hindered by my level of education. I needed to think from the perspective of someone who did not understand biology, which is hard for someone that has been studying the subject at the college level for four years. Her suggestion was to "dumb down" the information into a form where the reader would not know that they were looking at something educational. My flippant response was that perhaps I should use a cartoon gene, or even go as far as to name him "Levi." My mother stopped drinking her coffee and paused to ponder. After a few moments of reflection, she said that it was an absolutely wonderful idea. Her heartfelt enthusiasm encouraged me to pursue my sarcastically spoken inspiration with a few sketches to see if the idea would work. Hence, Levi the Gene was born.

The Painful Making of Levi

Now that I had a format in which I could bring understanding to my would-be reader in an artistic way, the ordeal of putting the concept into reality became horrifyingly clear. As a visual artist, I had never attempted cartooning of any sort. My work had been in realism and surreal styles of painting. I needed to research how to create cartoons, which I never realized was so difficult. An unwarranted number of instructional websites, cartoon books, and newspaper comics later, I had some basic level of competence in drawing Levi with different expressions, body positions, and actions. This was instrumental in creating the amusement that would allow people to learn from the children's book without it becoming drab or boring. The next step was to decide

exactly what Levi would be explaining to people, and to set limits to the amount of material I was going to cover in the book.

I decided to cover the basics of genetics. This choice was catalyzed by recent events in the media and politics wherein genetic research was being debated as ethical. One of the topics of my questionnaire asked the subject to explain exactly what genetic engineering was, and on this section people had done particularly poorly. My rationale was that as technology progresses, the topic would flow into the media more. People would be asked to decide if genetic research should be allowed under law, if genetically engineered foods should be consumed, or even if cloning or stem cell research should be pursued by science. I wanted a more educated public to decide if the ethics of genetic research should be amended to the constitution. Given that my personal research indicated that many people could not even accurately describe what a gene was, much less to what genetic engineering and research pertained, a more educated public is needed. It also fit particularly well with Levi, considering that he was a gene.

Starting from the presumption that the reader would know nothing about biology, it made sense to me that Levi should be unaware of what he was as well. I also decided that he should interact with an omniscient text that would lead him on a journey to find out more about himself. This would be more conducive to the learning process. If the reader were to learn along with Levi, instead of having him explain what he was, there would be a sense of solidarity. It would also make for more interactive learning, since the reader would be following Levi as he asked questions and occasionally would not understand concepts. I wanted to make him fallible and capable of being perplexed so

that the reader would recognize that these were hard concepts and that it was all right not to be able to comprehend them immediately.

The hardest parts of the painstaking and sometimes humbling process of creating Levi were the analogies in the book. The art of utilizing a well placed analogy for learning is not an easy one, as I have learned with my previous work as a tutor, but it has been the strongest learning tool in my teaching arsenal. When I attempted to teach a student a theory, I had to find a way to put the information into a form to which they could relate and understand. This usually meant real world applications of similar ideas. I brought that same idea to Levi. For every idea that was explained to Levi in his quest for self-knowledge, I had to have a fun way for the omniscient text to teach the information accurately in a way that almost everyone would understand.

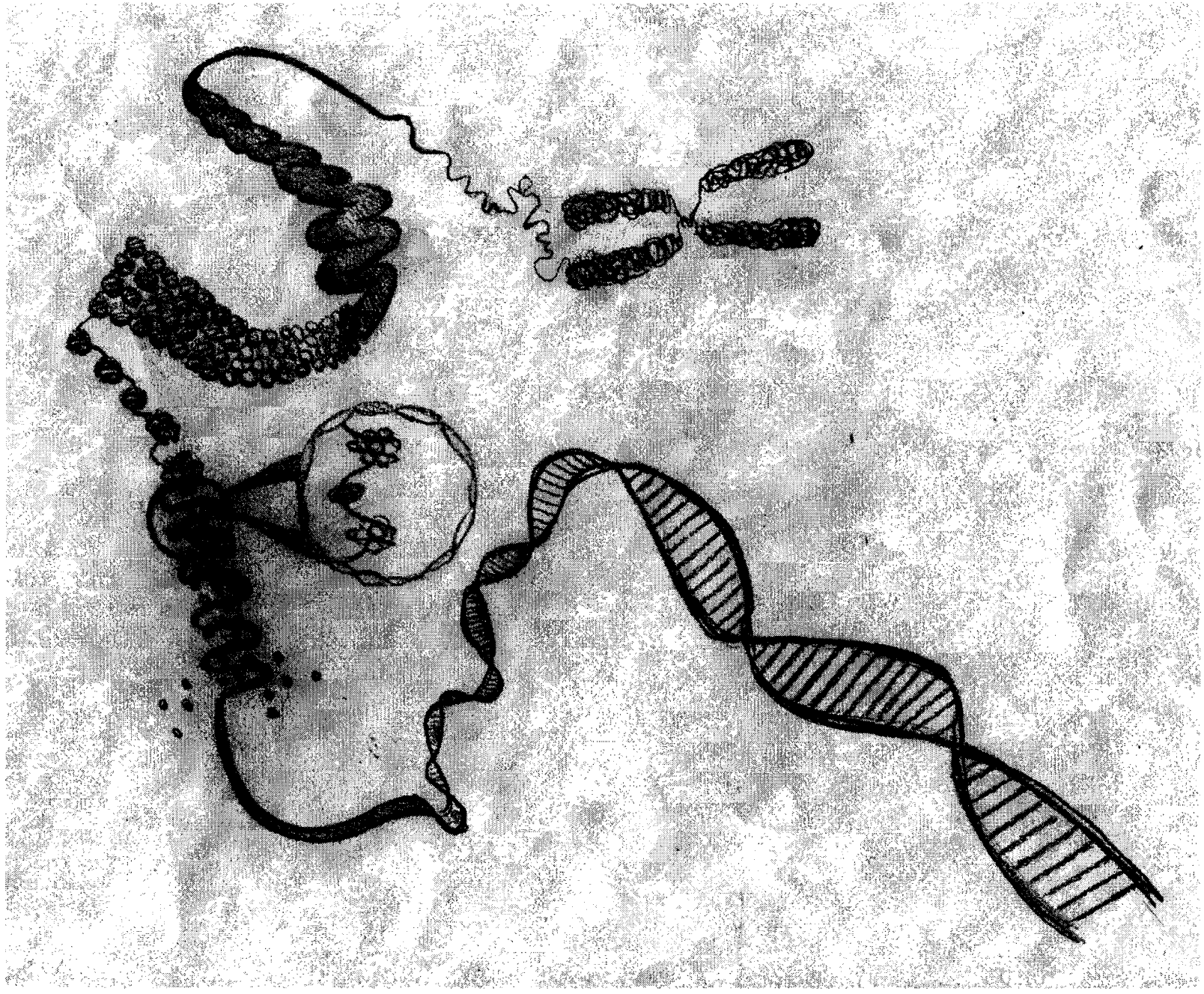
With my outline for the questions that Levi was going to answer, I took time during my spring break to come up with all the analogies. This was no simple feat, and there were times when I was so frustrated with my inability to simply explain what I knew so well that I wanted to give up. Even so, the greatest sources of my inspiration came from the kitchen and children's toys. Almost all of the ideas in biology relate to life at a larger level. Tools are utilized because their shape fits the need that they are trying to accomplish, and because anything that saves time makes life easier. Children's toys teach that you do not put a square block into a round hole. These ideas are conveniently scattered about the larger everyday world as well as the world of biology. This would be something that a young adult or child would understand, and they therefore would be able to relate to the material. With these analogies, the omniscient

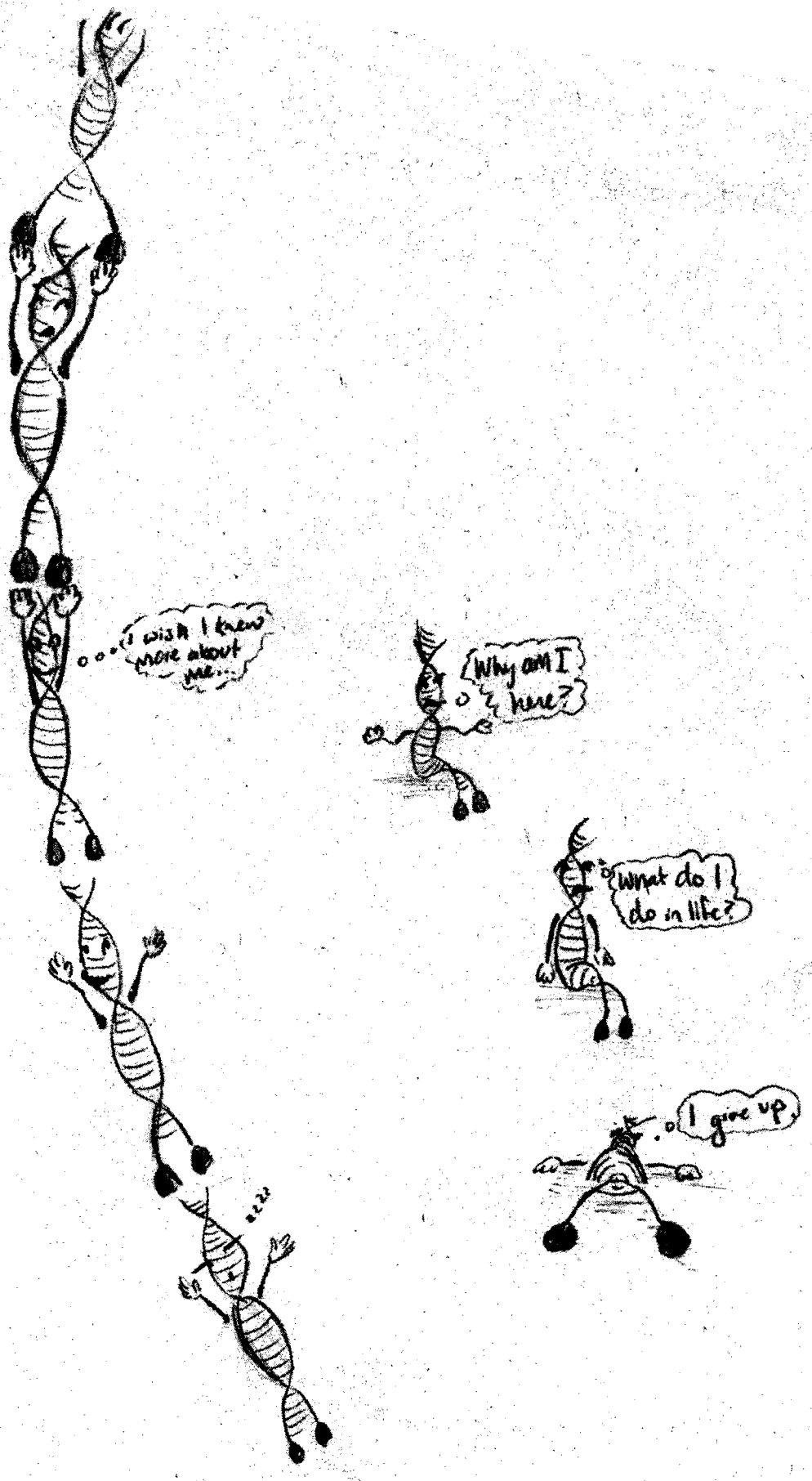
text had a way to explain the concepts of genetics to Levi, and through him, the reader as well, in an amusing and easily absorbed format.

The humor in the story was also difficult. I did not want this to be another mind-numbing learning tool where the reader would be put to into a mild coma with the constant barrage of facts and information, no matter how relevant it was. The comic relief included in the storyline was essential for the progress of book. My ultimate fear was that the completion of the project would reveal a book that did not make people laugh. Consequently, I spent a lot of time watching cartoons with children and trying to incorporate the humor displayed therein.

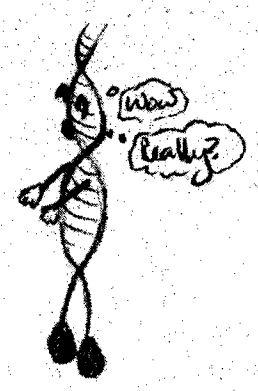
Technical Difficulties

When all was said and done with the creation of these sketches, they accomplished everything that I desired in a piece of educational children's literature which blended art and science. However, there will always be technical difficulties in any creative enterprise. Scanning Levi and cleaning the pages of my work with the aid of Photoshop and the university computer labs took some time, to name one such difficulty. With the deadline of graduation looming on the horizon, I have not had the time to shape Levi into the artistic creation that I feel would do him justice. The form in which Levi exists as a creative project for the honors college is in no way his finished format. Too much of my effort, thought, and passion went into him to allow him to be fully completed as he is now. My goals for this senior thesis have been attained, but for Levi it is only the beginning. I plan on correcting what I did not have the time or computer skills to perfect in the months to come. One day in the near future there will be a permanent home for Levi in a published children's book and website where he can continue to educate.

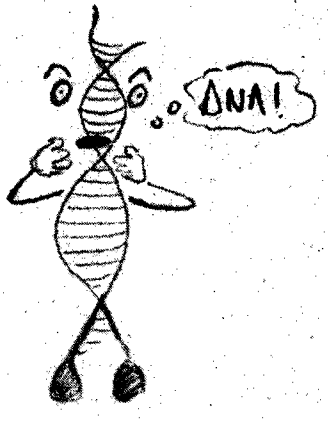


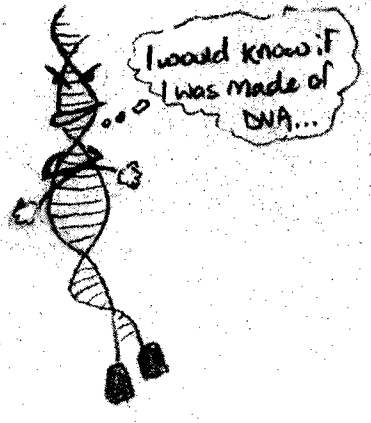

...I wish I knew more about me...
Why am I here?
What do I do in life?
I give up.

Don't worry, Levi, everyone thinks like that.

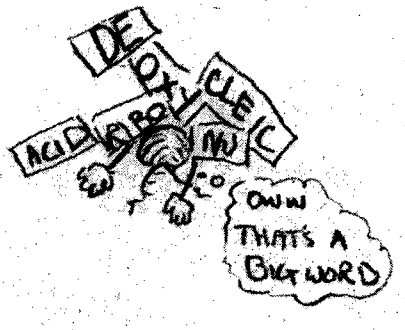


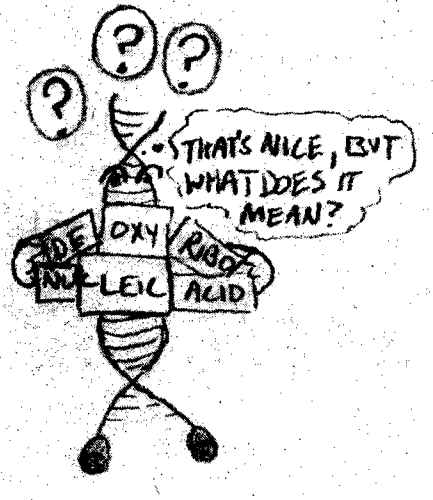
YES. LEVI, YOU'RE ONE OF THE MOST IMPORTANT THINGS ON THE PLANET. YOU'RE THE BASIS OF DNA!



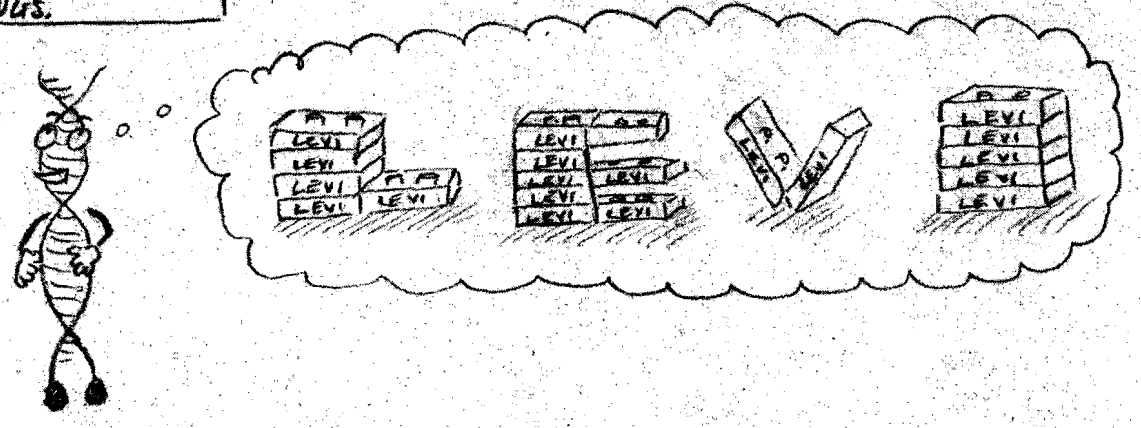


NO, LEVI. DNA IS A GOOD THING. IT STANDS FOR DEOXYRIBONUCLEIC ACID.

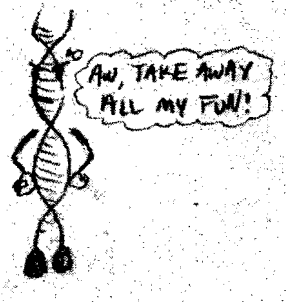




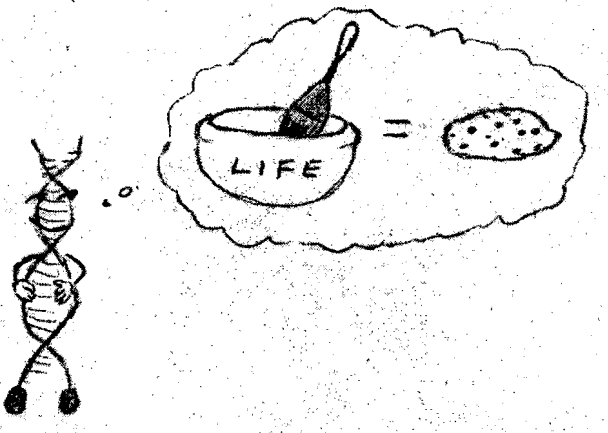
IT MEANS THAT YOU ARE THE BUILDING BLOCKS OF ALL LIVING THINGS.



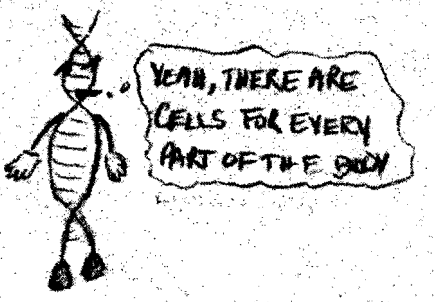
NO. NO. NO. NO. THAT'S NOT WHAT I MEANT.

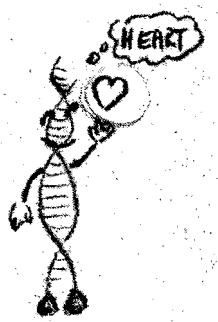


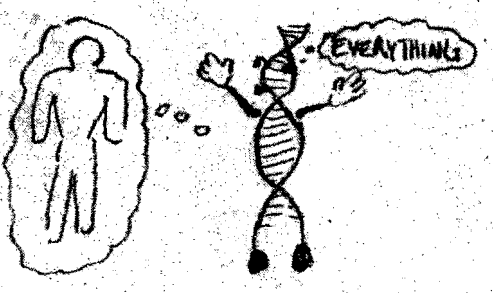
YOU ARE A GENE. THAT MEANS THAT YOU'RE THE RECIPE FOR MAKING ALL LIFE.



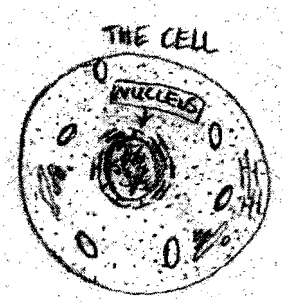
OK, LET'S TRY THIS ANOTHER WAY. LEVI, YOU KNOW THAT ALL LIVING THINGS ARE MADE OF CELLS, RIGHT?



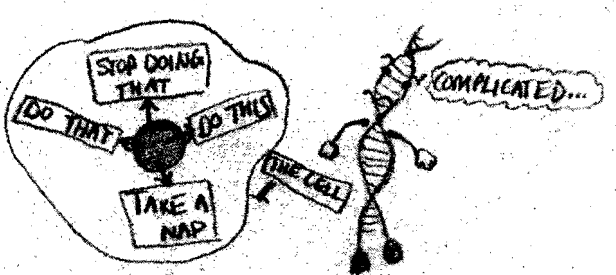




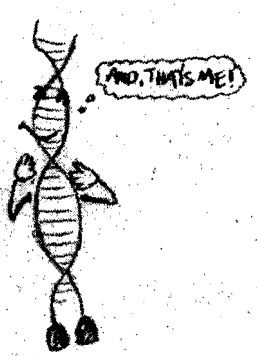
WELL, INSIDE EVERY CELL THERE IS A CENTRAL COMMAND CENTER, CALLED THE NUCLEUS.



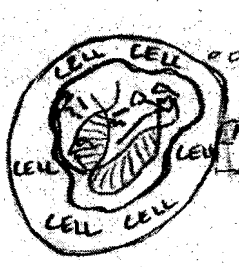
INSIDE THE NUCLEUS IS WHERE ALL THE COMMANDS FOR THE CELL COME FROM



THOSE DIRECTIONS COME FROM DNA!

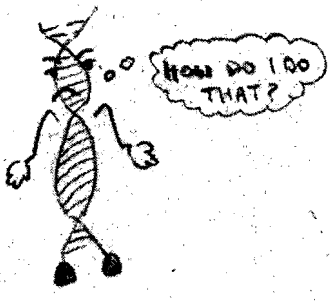


WELL, YOU ARE. YOU SEE, DNA PROVIDES INSTRUCTIONS FOR MAKING EVERY LIVING THING THE WAY THAT IT IS...



IT'S AWFULLY CRAMPED IN HERE

ALL FROM INSIDE THE CELL'S CENTER, THE NUCLEUS.



HOW DO I DO THAT?

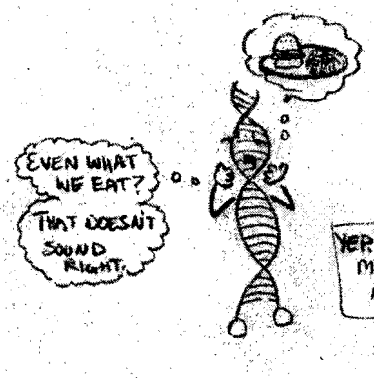
WELL, IT'S COMPLICATED. FIRST YOU NEED TO UNDERSTAND HOW DNA WORKS.

IT WORKS LIKE THIS:

NOW WAIT, YOU DIDN'T SAY ANYTHING ABOUT AMINO ACIDS BEFORE! GEEZ, I'M CONFUSED

DNA IS A SECRET CODE THAT TELLS YOUR BODY TO MAKE A STRING OF THE BUILDING BLOCKS OF PROTEIN, CALLED AMINO ACIDS

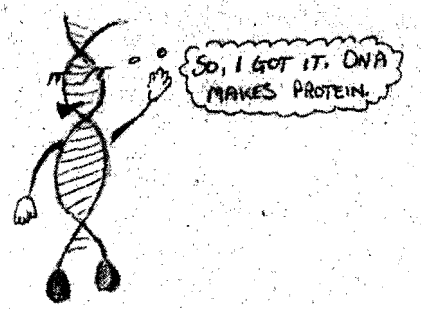
IT'S NOT THAT DIFFICULT. ALL PROTEIN IS MADE OF AMINO ACIDS.

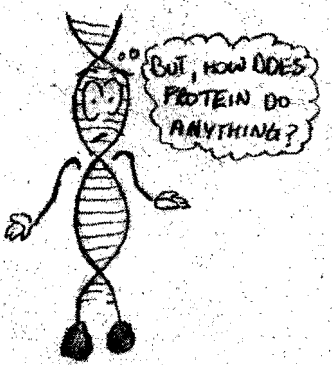


EVEN WHAT WE EAT?

THAT DOESN'T SOUND RIGHT.

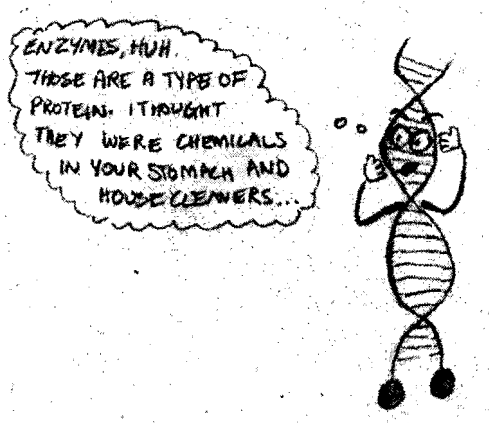
YEP. ALL PROTEIN, THAT INCLUDES MEAT-LIKE FISH, BEEF, AND CHICKEN AND PLANT PROTEIN-LIKE SOY.





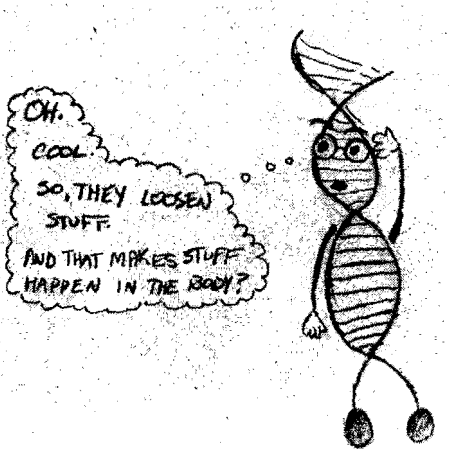
WELL, THERE IS MORE THAN JUST FOOD PROTEIN.

DOWN, REALLY SMALL, AT THE MICROSCOPIC LEVEL, PROTEIN COMES IN 2 TYPES.

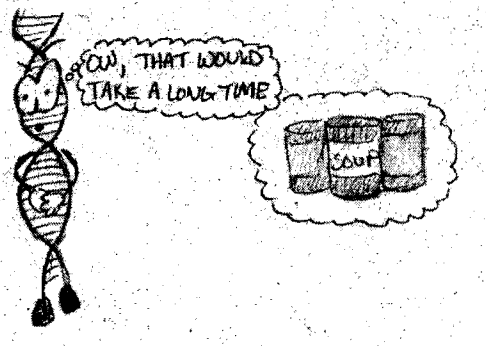


NO. ENZYMES ARE PROTEINS THAT BREAK THINGS DOWN SO THAT CHEMICAL REACTIONS GO FASTER IN THE BODY

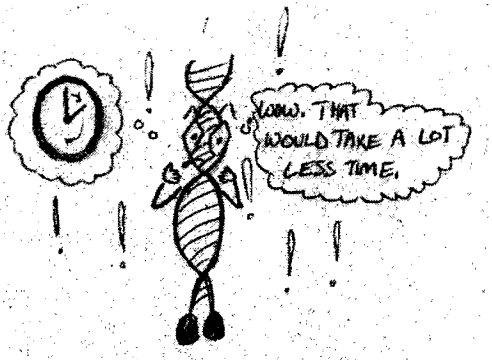
THEY ARE LIKE LITTLE MICROSCOPIC WRENCHES. THEY LOOSEN UP CHEMICALS SO YOUR BODY CAN BREAK THEM DOWN EASIER.



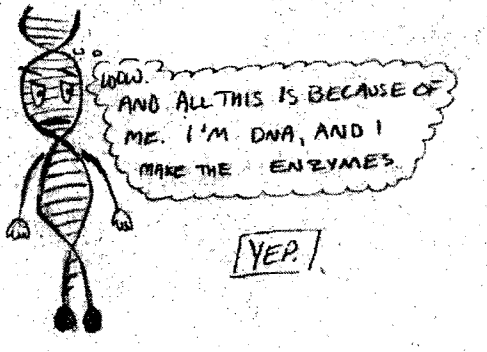
YES. IMAGINE IF YOU HAD TO OPEN 100 SOUP CANS WITHOUT A CAN OPENER.

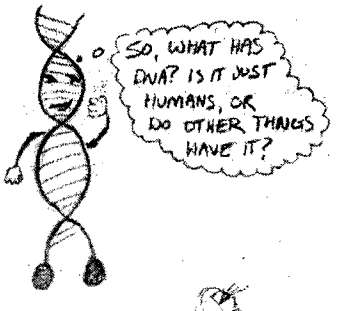


NOW, IMAGINE HOW MUCH TIME YOU WOULD SAVE BY DOING THE SAME ACTION WITH A CAN OPENER.

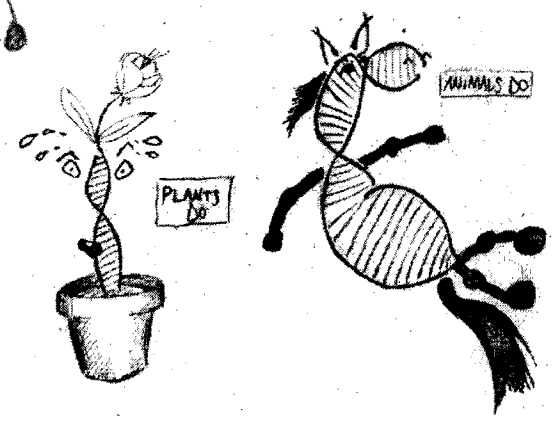


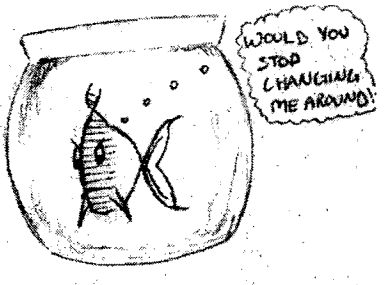
WELL, THAT'S WHAT ENZYMES DO. THEY SAVE TIME.
IN FACT, WITHOUT THEM, OUR BODIES WOULD SPEND SO MUCH TIME DOING THE THINGS THAT ENZYMES DO THAT THERE WOULDN'T BE TIME FOR ANYTHING ELSE.

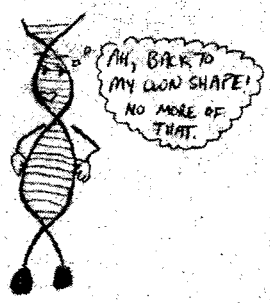


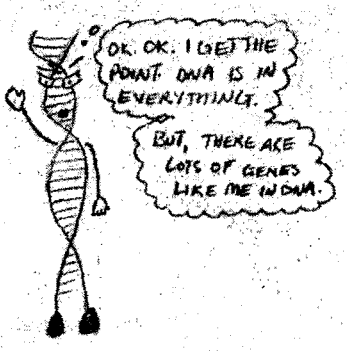


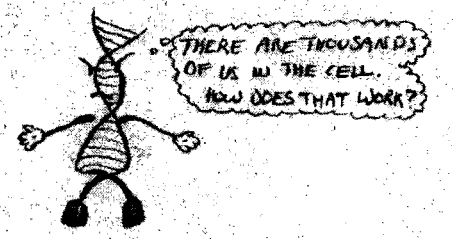
WELL, EVERYTHING THAT HAS CELLS HAS DNA.



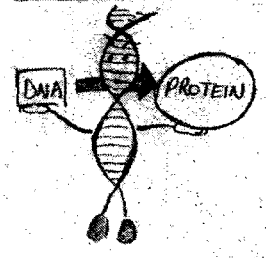




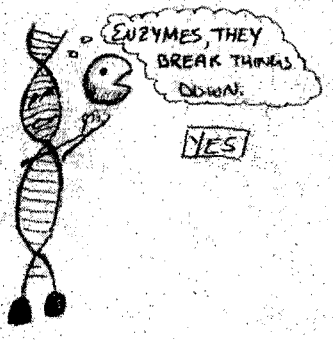




WELL, WE NOW KNOW THAT DNA MAKES PROTEIN.

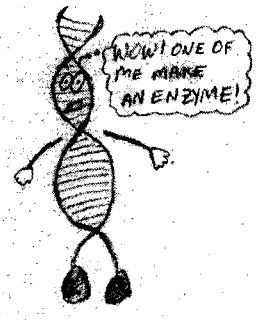


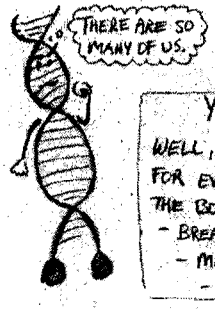
AND THE PROTEINS MADE ARE CALLED ENZYMES.



OK, GOOD. MOVING ON

EACH SECTION OF DNA THAT MAKES A SINGLE ENZYME IS CALLED A GENE



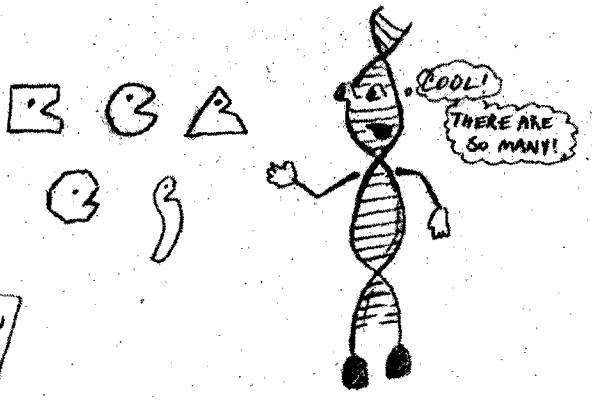


YEP.
WELL, ENZYMES ARE NEEDED FOR EVERY TYPE OF REACTION IN THE BODY.
- BREAKING DOWN FOOD.
- MAKING THE CHEMICALS WE NEED.
- MAKING MORE CELLS.

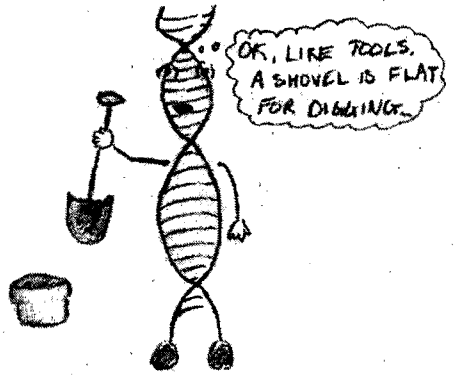
EVEN MAKING MORE DNA FOR NEW CELLS EVERYDAY

SO, A LOT OF DIFFERENT ONES ARE NEEDED.

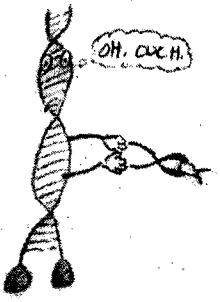
YES. SINCE ALL ENZYMES HAVE DIFFERENT PURPOSES MOST HAVE DIFFERENT SHAPES.



IN THE WORLD OF BIOLOGY, WHAT YOU LOOK LIKE IS VERY IMPORTANT FOR WHAT YOU DO.



AND A PAIR OF PLIERS FOR PULLING ON SOMETHING...



YEAH. AND SOME ENZYMES ARE MORE POWERFUL THAN OTHERS.

OH, YOU DON'T SAY...

I HADN'T NOTICED.

YES.
SOME GENES THAT MAKE ENZYMES ARE DOMINANT OR RECESSIVE.

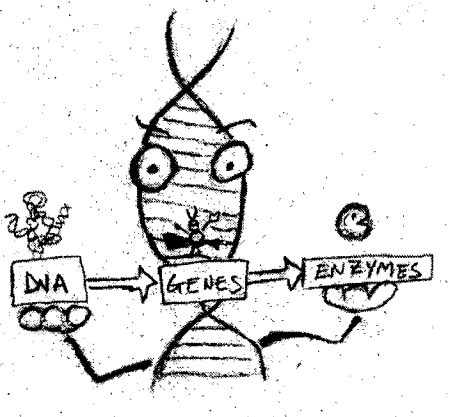
I DON'T UNDERSTAND

WELL, IT'S LIKE THIS...

SOME GENES ARE MORE POWERFUL THAN OTHER GENES WHEN YOU PUT THEM TOGETHER.

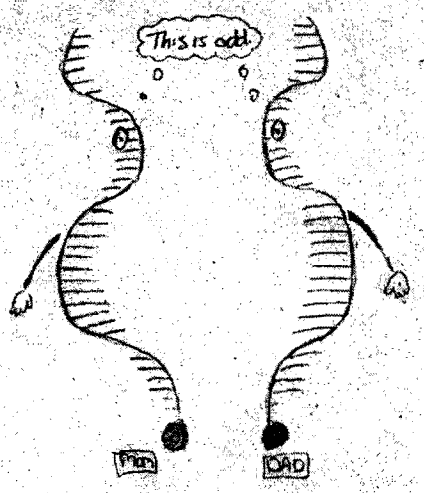
MORE WORK?

LESS WORK?

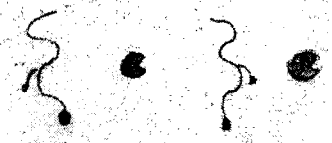


AND ENZYMES ARE MADE FROM GENES TO DO A JOB IN THE BODY

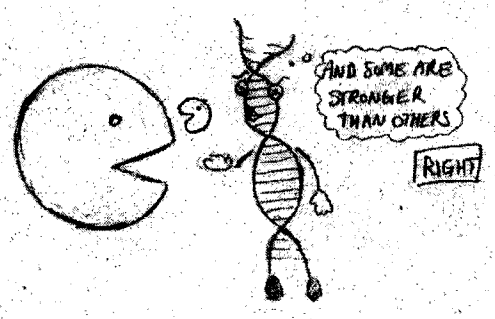
AND YOU HAVE A GENE FOR EVERYTHING. ONE HALF FROM EACH PARENT.



EACH OF THE TWO FORMS OF THESE GENES MAKES AN ENZYME.

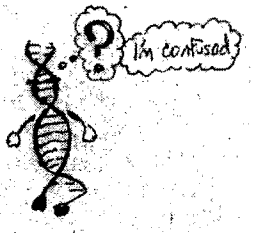


SO THERE ARE TWO ENZYMES FOR EVERY GENE.



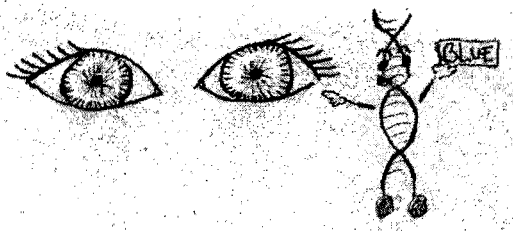
WELL, THAT'S WHY SOMETIMES CHILDREN LOOK MORE LIKE ONE PARENT THAN THE OTHER.

WOW. I'VE ALWAYS WONDERED HOW THAT WORKED.



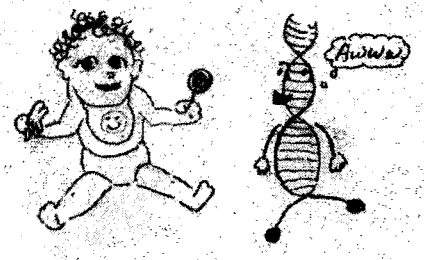
THE STRONGER GENE IS DOMINANT. WHEN THE DOMINANT GENE IS PRESENT, ITS EFFECTS WILL SHOW OVER THE RECESSIVE GENE.

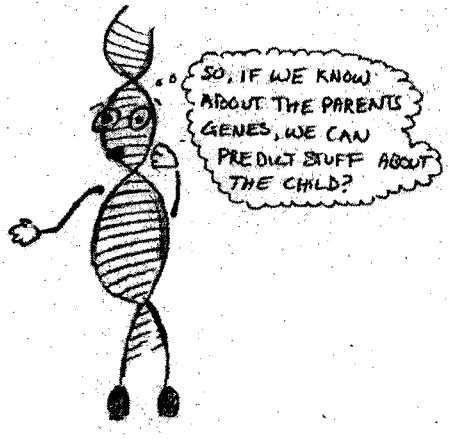
OK. YOU HAVE A MOTHER WITH BLUE EYES.



AND A FATHER WITH BROWN EYES.

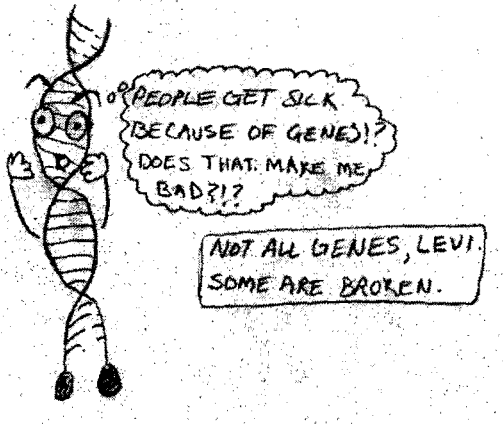
WHEN THEY HAVE A CHILD, CHANCES ARE THAT IT WOULD HAVE BROWN EYES

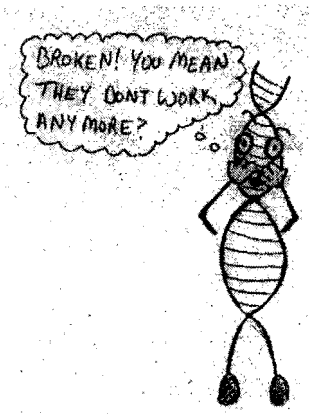




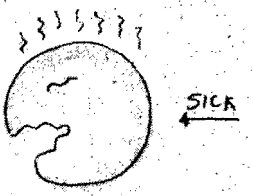
SOMETIMES. THAT IS WHY WE STUDY GENES. BUT IT IS NOT THE ONLY REASON.

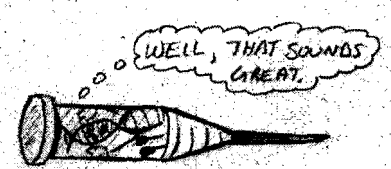
WE ALSO WANT TO UNDERSTAND WHY PEOPLE GET SICK, AND HOW TO FIX THEM.





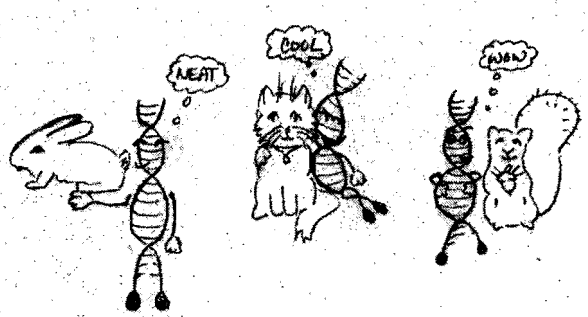
YES. THE GENE HAVE A PROBLEM AND THE ENZYMES THAT THEY MAKE DON'T WORK.





THAT'S WHY WE ARE RESEARCHING WAYS TO INJECT WORKING GENES INTO PEOPLE.

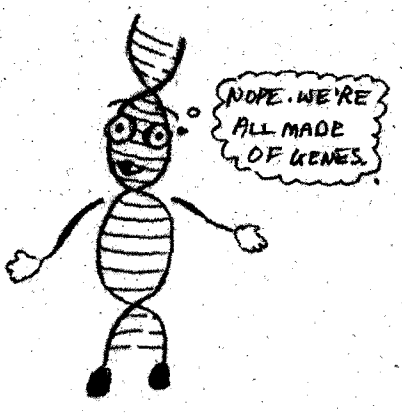
AND THAT'S NOT ALL. SCIENTISTS ALSO LOOK AT THE GENES OF OTHER CREATURES TO SEE IF WE CAN COMBINE THEM TO MAKE THINGS BETTER.



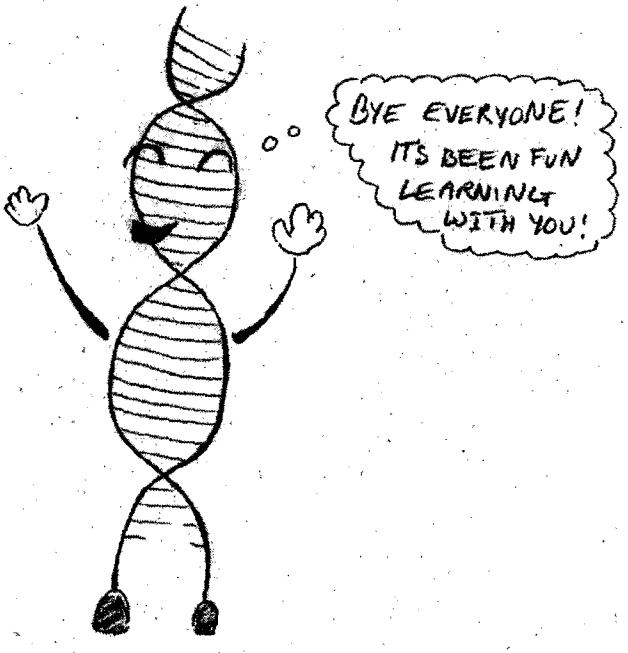
OR MAKE THE WORLDS CUTEST ANIMAL!

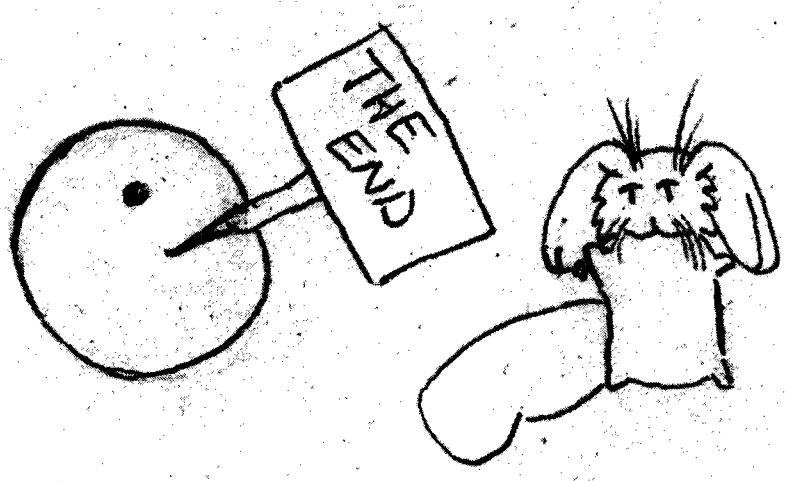
WELL, YEAH. BUT IT IS STILL NEAT KNOWING WHAT GENES CAUSE THE DIFFERENCES BETWEEN LIVING THINGS.

WE ARE NOT AS DIFFERENT AS WE THINK WE ARE.



SO IT'S TIME TO SAY GOODBYE.




THE END